

Amendments to the Claims

Kindly replace original claims 1-29 with the following substitute claims. This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) Detector module (1) for a Positron Emission Tomograph (PET) comprising
 - a matrix (3) of scintillator crystals (2), said matrix (3) having a first side and a second side opposite to said first side, each scintillator crystal (11) having a first end (14) and a second end (15), said scintillator crystals (2) being oriented parallel to each other, whereby said first end (14) and said second end (15) of each of said scintillator crystals (2) coincide with said first side and said second side of said matrix (3), respectively;
 - a first light sensitive detector (6) producing an electrical signal proportional to the amount of light detected, being optically connected to said first side of said matrix (3), said first light sensitive detector (6) being position sensitive; and
 - a second light sensitive detector (7) producing an electrical signal proportional to the amount of light detected, said second light sensitive detector (7) being optically connected to said second side of said matrix (3), being position sensitive.
2. (currently amended) Detector module (1) for a Positron Emission Tomograph (PET) according to claim 1, wherein said first light sensitive detector (6) and said second light sensitive detector (7) are segmented such that at least one segment in each of said light sensitive detectors (6,7) corresponds to each of said scintillator crystals (2) in said matrix (3).
3. (currently amended) Detector module (1) for a Positron Emission Tomograph (PET) according to claim 2, wherein segmentation patterns of said light sensitive detectors (6,7) match patterns of their respective matrix sides.

4. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the claims 1 to 3~~ claim 1, wherein said first light sensitive detector (6) is a Hybrid Photo Diode (HPD) detector.
5. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the claims 1 to 4~~ claim 1, wherein said second light sensitive detector (7) is a Hybrid Photo Diode (HPD) detector.
6. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the claims 1 to 5~~ claim 1, wherein said matrix (3) has a rectangular pattern or a stonewall pattern with a first direction (y) parallel to one side of said rectangular pattern; said scintillator crystals (2) comprise a crystal material and an added crystal material length along said first direction (y) corresponds to about three times the absorption length of photons (γ_1, γ_2) with a primary photon energy to be detected in said crystal material.
7. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to claim 6, wherein said matrix (3) comprises 12 x 18 scintillator crystals (2).
8. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the above claims~~ claim 1, wherein said crystal material comprises Cerium doped Yttrium Aluminum Perovskite (YAP:Ce).
9. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the claims 1 to 7~~ claim 1, wherein said crystal material comprises Cerium doped Lutetium Oxyortho-silicate (LSO:Ce) or LuAP:Ce.
10. (currently amended) Detector module (4) for a Positron, Emission Tomograph (PET) according to ~~any of the above claims~~ claim 1, wherein said scintillator crystals (2) have the dimensions of 3.2 x 3.2 x 100 mm³.

11. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the above claims~~ claim 1, wherein said scintillator crystals (2) are spaced in said matrix (3) by wires strung between said scintillator crystals (2) close to said first and said second side of said matrix (3).
12. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the above claims~~ claim 1, wherein said wires have a diameter of 0.8 mm.
13. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) as ~~defined by claims 10 and 12~~ according to claim 10, wherein said segments of said first and said second light detector (6, 7) have the dimensions of 4 mm x 4 mm.
14. (currently amended) Detector module (4) for a Positron Emission Tomograph (PET) according to ~~any of the above claims~~ claim 1, wherein said scintillator crystals (2) comprise crystal segments glued together with a glue having a matched refractive index as said crystal segments.

15. (currently amended) Positron Emission Tomograph (PET) scanner comprising a number of gamma detector modules ~~(1)~~ characterized in that
said gamma detector modules each comprise a detector module ~~(1)~~ comprising
- a matrix ~~(3)~~ of scintillator crystals ~~(2)~~, each scintillator crystal ~~(11)~~ having a first end ~~(14)~~ and a second end ~~(15)~~, said scintillator crystals ~~(2)~~ being oriented parallel to each other such that all mid points of said scintillator crystals ~~(2)~~ lie in one plane;
 - a first light sensitive detector ~~(6)~~ and a second light sensitive detector ~~(7)~~, each of said light sensitive detectors ~~(6,7)~~ produces an output signal proportional to the amount of light detected and is position sensitive;
- said number of gamma detector modules ~~(1)~~ are regularly angularly spaced on a first ~~(51)~~ and a second circle ~~(52)~~ around an axis ~~(53)~~ of said scanner and oriented such that all midpoints of said scintillator crystals ~~(2)~~ of said detector modules ~~(1)~~ lie in a symmetry plane perpendicular to said axis ~~53~~, whereby the spacing and distribution of said gamma detector modules ~~(1)~~ on said first and said second circle ~~(51,52)~~ is such that there is no line of sight in a direction perpendicular to said axis ~~(53)~~ radial outward from the cross section of said axis ~~(53)~~ with said symmetry plane, such that there is practically a full azimuthal coverage.
16. (currently amended) Positron Emission Tomograph (PET) scanner according to claim 15, wherein said angular spacing between a first one of said gamma detector modules ~~(1)~~ being localized on said first circle ~~(51)~~ to an adjacent second one of said gamma detector modules ~~(1)~~ localized on said second circle ~~(52)~~ is 15°.

17. (currently amended) Method for detecting the point of interaction of a gamma ray (y_1, y_2) within a detector module (1) comprising

- a matrix (3) of scintillator crystals (2), each scintillator crystal having a first end (14) and a second end (15), said scintillator crystals (2) being oriented parallel to each other such that all mid points of said scintillator crystals (2) lie in a plane;
- a first light sensitive detector (6) and a second light sensitive detector (7), each of said light sensitive detectors (6,7) produces an output signal proportional to the amount of light detected and is position sensitive;

said detector module (1) having a coordinate system associated with, whereby two linear independent coordinate axes χ and γ span a $\chi\gamma$ -plane coinciding with said plane defined by said midpoints of said scintillator crystals (2) and a third coordinate axis z is oriented perpendicular to said plane whereby an origin of said coordinate system lies in said $\chi\gamma$ -plane and a positive direction of said coordinate axis z points to said first light sensitive detector (6), said method comprising the steps

- determining the coordinates of said point of interaction in said $\chi\gamma$ -plane by identifying a first scintillator crystal being hit and using the known coordinates of said first scintillator crystal being hit in said $\chi\gamma$ -plane ;
- determining the coordinate of said point of interaction in said direction (z) perpendicular to said $\chi\gamma$ -plane by determining the amount of charge Q_1 detected in said first light sensitive detector (6) and an amount of charge Q_2 detected in said second light sensitive detector (7) within a coincidence time interval, where the

coordinate z is given by

where L is the length of said first

scintillator crystal (11).

18. (currently amended) Method for detecting the point of interaction of a gamma ray (γ_1, γ_2) within, a PET detector module ~~(1)~~ according to claim 17, wherein said determined coordinate is considered to be valid, if the total amount of charge ($Q_1 + Q_2$) detected by said first and said second light sensitive detectors ~~(6, 7)~~ equals a reference charge corresponding to a predetermined photon energy.
19. (currently amended) Method for detecting the point of interaction of a gamma ray (γ_1, γ_2) within a PET detector module ~~(1)~~ according to claim 17 ~~or 18~~, where the determined coordinate is considered to be valid, if the total amount of charge ($Q_1 + Q_2$) detected by said first and said second light sensitive detectors ~~(6, 7)~~ originating from said first scintillator crystal ~~(12)~~ hit is lower than 60% of said reference charge, corresponding to said predetermined photon energy, and a second coordinate is determined according to the method of claim 18 in a same coincidence time interval, associated with a different scintillator crystal ~~(13)~~ hit and the charges detected by said first light sensitive detector ~~(6)~~ and said second light sensitive detector ~~(7)~~ originating from said different scintillator crystal ~~(13)~~ hit are Q_3 and Q_4 , respectively, and the total amount of charges ($Q_1 + Q_2 + Q_3 + Q_4$) detected by said first light sensitive detector ~~(6)~~ and said second light sensitive detector ~~(7)~~ originating from said first scintillator crystal ~~(12)~~ hit and said different scintillator crystal ~~(13)~~ hit is about equal to said reference charge and said coordinate is closer to the source emitting the gamma ray than said second coordinate.
20. (currently amended) Single Photon Emission Computed Tomography detector comprising a photon detector characterized in that said photon detector is a detector module ~~(1)~~ for a Positron Emission Tomograph according to any of the ~~claims 1 to 14~~ claim 1.

21. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ comprising
- a vacuum containment, said vacuum containment ~~(4, 21, 22)~~ having a flat entrance window ~~(4)~~ at a top and a base ~~(22)~~ at a bottom opposite to said top;
 - semi transparent visible light bialkali photocathode ~~(23)~~ deposited inside said vacuum containment ~~(4, 21, 22)~~ at said top parallel to said entrance window ~~(4)~~;
 - a semiconductor sensor ~~(8)~~ mounted inside said vacuum containment ~~(4, 21, 22)~~ on said base ~~(22)~~, said semiconductor sensor ~~(8)~~ comprising segments;
 - a self triggering electronic circuitry for reading out each of said segments separately, being mounted inside said vacuum containment ~~(4, 21, 22)~~ at said base ~~(22)~~;
 - an electron optic ~~(24, 25)~~ providing a 1:1 imaging of photo electrons from said semi-transparent visible light bialkali photocathode ~~(23)~~ onto said semiconductor sensor ~~(8)~~.
22. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to claim 21, wherein said base ~~(22)~~ comprises a ceramic material.
23. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to ~~claims 21 or 22~~ claim 21, wherein said semiconductor sensor ~~(8)~~ is a silicon sensor.
24. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to ~~any of the claims 21 to 23~~ claim 21, wherein said self triggering circuitry comprises
- one channel for each segment of said semiconductor sensor ~~(8)~~;
 - a charge integrating preamplifier for each of said channels;
 - a shaper for each of said channels; and
 - a readout register for each of said channels.
25. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to claim 24 wherein said shaper has a tunable shaping time.

26. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to ~~any of the claims 21 to 25~~ claim 21, further comprising a parallel fast shaper circuit for producing a trigger signal for a readout logic.
27. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to ~~any of the claims 21 to 26~~ claim 21, wherein said electron optics comprise any suitable number of ring electrode ~~(24, 25)~~.
28. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to ~~any of the claims 21 to 27~~ claim 21, wherein said bialkali photocathode ~~(23)~~ is directly deposited on the inside of said entrance window ~~(4)~~.
29. (currently amended) Hybrid Photo Diodes (HPD) detector ~~(6)~~ according to ~~any of the claims 21 to 28~~ claim 21, wherein said entrance window ~~(4)~~ is comprising sapphire.